



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C63e

Effective
Date: 10/1/16

Technical Standard Order

Subject: Airborne Weather Radar Equipment

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your airborne weather radar equipment must first meet for approval and identification with the applicable TSO marking. This TSO addresses weather detection and ground mapping, forward looking windshear detection, forward looking turbulence detection, and atmospheric threat awareness capability. It does not include flight guidance system functionality in support of an approved windshear detection and avoidance system.

2. **APPLICABILITY.** This TSO affects new applications submitted after its effective date.

a. TSO-C63d will remain effective until April 1, 2018. After this date, we will no longer accept applications for TSO-C63d.

b. Airborne weather radar equipment approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. **REQUIREMENTS.** New models of airborne weather radar identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements set forth in RTCA Document, DO-220A, *Minimum Operational Performance Standards for Airborne Weather Radar Systems*, dated March 17, 2016 for the equipment classes defined in Table 1.

Table 1 – Airborne Weather Radar Equipment Classes and Applicable MPS

Equipment Class	Equipment Type	Minimum Performance Standards
A	Forward-Looking Windshear Detection Capability	RTCA/DO-220A, section 2.2, with the following exclusions: paragraphs 2.2.1.3.6, 2.2.1.3.7, 2.2.2, 2.2.4, and 2.2.5.
B	Forward-Looking Turbulence Detection Capability	RTCA/DO-220A, section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.7, 2.2.2, 2.2.3, and 2.2.5.
C	Airborne Weather and Ground Mapping Radar	RTCA/DO-220A, section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.6, 2.2.1.3.7, 2.2.3, 2.2.4, and 2.2.5.
D	Atmospheric Threat Awareness Capability	RTCA/DO-220A, section 2.2, with the following exclusions: paragraphs 2.2.1.3.5, 2.2.1.3.6, 2.2.2, 2.2.3, and 2.2.4.

a. Functionality. This TSO's standards apply to equipment intended to:

(1) Provide airborne windshear detection (Equipment Class A). Equipment Class A provides forward-looking windshear detection functionality. However, this TSO does not include flight guidance system functionality in support of an approved windshear detection and avoidance system.

(2) Provide advanced and advisory indication of potentially hazardous turbulence conditions detectable by radar, together with other flight information, to assist pilots with turbulence avoidance decisions (Equipment Class B).

(3) Detect and display echoes from precipitation to assist in flight crew analysis of weather. Maintain contact with geographic features such as international shoreline boundaries as a supplement to navigational orientation (Equipment Class C).

(4) Provide timely and advisory information to pilots to enhance their situational awareness of atmospheric activity and assist with atmospheric threat avoidance decisions (Equipment Class D).

b. Failure Condition Classifications.

- (1) Failure of the function defined in paragraphs **3.a(2)** or **3.a(4)** resulting in unannunciated malfunction of the function is a minor failure condition.
- (2) Failure of the function defined in paragraph **3.a(1)** or **3.a(3)** resulting in unannunciated malfunction or missed detection of the function is a major failure condition.
- (3) Loss of the functions defined in paragraph **3.a** is a minor failure condition.
- (4) Design the system to at least these failure condition classifications.

c. **Functional Qualification.** Demonstrate the required functional performance under the test conditions specified in RTCA/DO-220A for each included equipment class, as specified in Table 2.

Table 2 – Airborne Weather Radar Equipment Classes and Applicable Test Requirements

Equipment Class	Performance Test Requirements
A	RTCA/DO-220A, paragraphs 2.4.3.1, 2.4.3.3, and 2.4.4.1 in section 2.4.
B	RTCA/DO-220A, paragraphs 2.4.3.1, 2.4.3.4, and 2.4.4.2 in section 2.4.
C	RTCA/DO-220A, paragraphs 2.4.3.1 and 2.4.3.2 in section 2.4.
D	RTCA/DO-220A, paragraphs 2.4.3.1, 2.4.3.5, and 2.4.4.3 in section 2.4.

d. **Environmental Qualification.** For all equipment classes, demonstrate the required performance under the test conditions specified in RTCA/DO-220A, Section 2.3, using standard environmental conditions and test procedures appropriate for airborne equipment. You may use different standard environmental conditions and test procedures than specified in RTCA/DO-220A.

Note: The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.g** of this TSO.

e. **Software Qualification.** If the article includes software, develop the software according to RTCA Document, DO-178C, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 13, 2011, including referenced supplements as applicable, to at

least the software level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. You may also develop the software according to RTCA, Inc. document RTCA/DO-178B, dated December 1, 1992 if you follow the guidance in AC 20-115C, *Airborne Software Assurance*, dated July 19, 2013.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according to RTCA Document, RTCA/DO-254, *Design Assurance Guidance for Airborne Electronic Hardware*, dated April 19, 2000, to at least the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.

g. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number. Mark each article according to Equipment Class(es) from Table 1 above.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

- (1) Each component that is easily removable (without hand tools), and
- (2) Each subassembly of the article that you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. You may use electronic part marking to identify software or electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.g**) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

(2) For Equipment Class B, identify the installation instructions for the identified Aircraft Class selected from RTCA/DO-220A, paragraph 2.2.4.1, Table 2-4.

(3) Expected radome performance for the electromagnetic signals passing through it (paragraph 2.2. of RTCA/DO-213A, *Minimum Operational Performance Standards for Nose-Mounted Radomes*, dated March 17, 2016).

(4) Weather performance index (range) in accordance with the requirements of RTCA/DO-220A.

(5) Windshear detection range in accordance with the requirements of RTCA/DO-220A.

(6) Describe in detail any deviations.

(7) Installation procedures and limitations sufficient to ensure that the airborne weather radar, when installed according to the installation or operational procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

“This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.”

(8) For each unique configuration of software and airborne electronic hardware, reference the following:

(a) Software part number including revision and design assurance level;

(b) Airborne electronic hardware part number including revision and design assurance level; and

(c) Functional description.

(9) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.

(10) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the airborne weather radar.

(11) List of replaceable components, by part number, that make up the airborne weather radar. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of airborne weather radar. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC) software configuration index, and software accomplishment summary.

d. If the article includes complex custom airborne electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

e. Nameplate drawing with the information required by paragraph 4 of this TSO.

f. Identify functionality, or performance contained in the article not evaluated under paragraph 3 of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications and software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph 3.

(2) Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph 5.f.(1).

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph 5.f.(1).

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph 5.f.(1).

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph 5.f.(1).

g. The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

h. Material and process specifications list.

i. List of all drawings and processes (including revision level) that define the article's design.

j. Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Equipment calibration procedures.

c. Schematic drawings.

d. Wiring diagrams.

e. Material and process specifications.

f. The results of the environmental qualification tests conducted according to paragraph **3.d.** of this TSO.

g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B or RTCA/DO-178C specified in paragraph **3.e** of this TSO, including all data supporting the applicable objectives in RTCA/DO-178B Annex A, *Process Objectives and Outputs by Software Level*.

h. If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with the design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-1. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

i. If the article contains non-TSO function(s), you must also make available items **6.a** through **6.h** as they pertain to the non-TSO function(s).

7. FURNISHED DATA REQUIREMENTS.

a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the airborne weather radar equipment.

b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.f.(1)** through **5.f.(4)**.

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.

c. Order copies of 14 CFR parts 21 and 25 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

d. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov>. You will also find the TSO Index of Articles at the same site.



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